SATURATION DIP MEASUREMENTS OF HIGH-J TRANSITIONS IN THE $v_1 + v_3$ BAND OF C_2H_2: ABSOLUTE FREQUENCIES AND SELF-BROADENING

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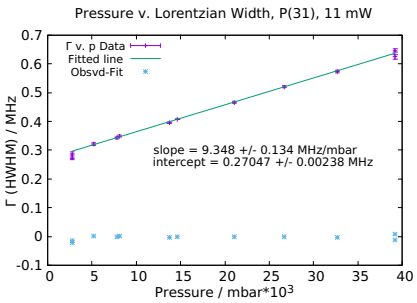

Saturation dip spectra of acetylene in the $v_1 + v_3$ band have been obtained for rotational lines with $J = 31 - 37$ inclusive, using a diode laser referenced to a frequency comb. The estimated accuracy and precision of the measurements is better than 10 kHz in 194 THz. Data were obtained as a function of sample pressure to investigate the broadening of the saturation features. The observed line shapes are well modeled by convolution of a fixed Gaussian transit-time and varying Lorentzian lifetime broadening, *i.e.* a Voigt-type profile. The lines exhibit a significantly larger collisional (lifetime) broadening than has been measured in conventional Doppler and pressure-broadened samples at ambient temperatures. The figure shows the fitted Lorentzian width versus sample pressure for P(31). The slope of this plot gives the pressure broadening coefficient, $\gamma_{self} = 9.35(13)$ MHz/mbar. For comparison, the coefficient derived from conventional Doppler and pressure broadened spectra for this transition is 2.7 MHz/mbar[c]. The sub-Doppler broadening coefficients are all significantly larger than the conventionally measured ones, due to the increased importance of velocity-changing collisions. The measurements therefore give information on the balance between hard phase- or state-changing and large cross-section velocity-changing collisions.

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